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Vol.			*Vol.*		
I	3 parts,	1928	VI	2 parts,	1933
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IV	4 ,,	1931	IX	4 ,,	1938
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Quarterly publication will be continued in future.

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THE following were the numbers and year of issue of the *Circular* :—

Vol.	1,	1920, 12 parts	Vol.	4,	1923, 1 part
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As Number 4 of Vol. 3 was printed as " Volume 4 " and Number 1 of Vol. 4 as " Volume 5 " it would appear from an inspection of a complete set that Volume 4 had only a Part 4 and that there were two issues of Volume 5, Part 1.

—EDITOR.

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VOLUME 11, NO. 1, MARCH, 1940.

NOTE.

WITH reference to the article "Raising Vegetables by Water-Culture," on page 121 of Volume 10, No. 4 of this Journal, some difficulty has been experienced in obtaining supplies of Monopotassium Phosphate, which is one of the ingredients of Solution C as described in the article. It is therefore necessary to alter the formula of this solution to include chemicals that are more readily obtainable and the formula should now read:—

SOLUTION C.

Two (2) level teaspoonfuls Superphosphate (the common fertilizer).
One (1) level teaspoonful Sodium Nitrate (the common fertilizer, Nitrate of Soda).
Two and a half ($2\frac{1}{2}$) teaspoonfuls Magnesium Sulphate (Epsom Salts).
One (1) level teaspoonful Potassium Chloride.

The formulae for Stock Solution A and Stock Solution B, and all directions for use, remain unaltered.

AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 11.] MARCH, 1940. [No. 1.

EDITORIAL.

THE first issue for the year 1940 finds the Empire at war with Nazi Germany and the importance of each colony limiting its imports of essential foods by an increased production of locally grown crops is of paramount importance and is being realized by all races in this Colony.

In this connexion the two articles on Fijian farmers are of especial value, one dealing with the establishment of a co-operative market at Nausori and the other with independent farmers in Cakaudrove Province. Both show what the exempt Fijian can do with only limited supervision and advice when he is given the opportunity. The cultivation of maize is also a timely article which will help those who are planting this valuable crop.

Another item of importance is the article on the storage of root crops, being an extract of a recent publication by the Colonial Office with special reference to cassava, sweet potatoes and yams which are of great local value.

The first article contributed by the Conservator of Forests is on the seasoning of the local kauri and shows what a large percentage of water is to be found in even partially-seasoned timber and indicates the importance of prospective buyers weighing and measuring a few samples of the timber offered for sale.

The summary of Mr. Simmonds' work in the Far East on his tour to obtain predacious insects for controlling the rhinoceros beetle of coconuts and the house-fly will be carefully read by all residents in the Pacific Islands and the results awaited with interest.

Turning to the more technical articles, that on the vitamin C value of local fruits and vegetables shows that Fijian citrus, soursop, paw paw and other fruits compares very favourably with values received from other countries. This is of especial confort to those with children, particularly to residents outside Suva, who can feel reassured of the high vitamins value of the fruit from their plantations.

The culture of fresh-water fish has not received in Fiji the attention it deserves and the article on this subject is worthy of serious consideration being written from first-hand information on the subject obtained in Java and Malaya. It fits in well with the article on the introduction of trout which appeared in the November issue of the Journal.

An interesting practical article on the preparation of vanilla should be useful. The entomological articles deal with pests of cotton, maize and various imported fruits and vegetables. The appearance of corn ear-worm on maize is enough to cause some apprehension as this caterpillar has definite tastes for particular crops, the maize " race " not normally attacking cotton or tomato and *vice versa*. Reports of this pest from any locality would be of great interest. The Jassid leaf-hopper on cotton is fortunately not as serious in Fiji as it is in most other cotton-growing countries.

FRESH WATER FISH CULTURE.

By
H. W. JACK, M.B.E., D.Sc., B.A.,
Director of Agriculture, Fiji.

THE striking paucity of fresh water fish in Fiji in comparision with their abundance in Java and Malaya indicates that much more could readily be done here to increase supplies of fresh water fish in addition to seafish with considerable advantage to local diet.

In Java and Malaya artificial fish-ponds are seen everywhere and in all sizes from a few square feet up to a quarter of an acre or even more, but the most common ponds are those approximately 30 x 15 x 4 feet deep. Practically every rice grower (wet rice) maintains at least one such pond on his holding, the average size of such holdings being rather less than two acres. During the rice-growing period the land is submerged to a depth of several inches and the fish thrive on the abundant insects, algæ, etc., found in the rice fields. At the end of the rice season. the land is drained off for the harvest and the fish are all driven into the fish pond, usually situated at a corner of the field where the water drains off from the land.

It has been estimated that the average fish pond receiving the fish from an acre of land after draining it for the rice harvest, holds about 25 cwts. of edible fish. Most of these are netted, cleaned, sun dried and salted or smoked to provide nutritive food over the next six months for the family, until the rice fields are again flooded. Some fish are, however, always left in the fish ponds where they breed prolifically to supply the young fish for rice fields in the next season and as they grow rapidly, the inundated rice fields provide a constant supply of fresh fish throughout the rice season.

This general practice ensures to the rice cultivator a constant supply of wholesome fish all the year round, the fish being mostly eaten with curried rice which is freshly pounded about once a week and is never polished. Hence, the diet of the Malay or the Javanese peasant is always a well balanced one since such peasants invariably also keep numerous ducks and poultry for food and consume an abundance of grated tender coconut meat, fresh sago, water cress, spinach, some beans, maize, cucumber, melons, limes, pumeloes, rambutans, pineapples, pulasans, belimbing, durians, guava, soursop, bananas and other fruits, all of which—a few trees of each—are usually grown on the homestead which rarely exceeds half an acre.

Efforts have been made to compute the aggregate areas of fish ponds in some districts of Java, omitting all the small rice growers ponds—in the Preanger district of Java alone the area is estimated at 7,500 acres—this district being about the size of the island of Viti Levu.

In developing fish-ponds, as can be expected, natural ponds are utilised and improved from year to year, the smaller ponds being dug entirely by the peasants themselves, although usually two or three families will help one another. In Malaya the large ponds, approximately 100 x 50 x 3½ feet deep, are almost entirely made by Chinese squatters, who frequently hire labour to assist them and who use the ponds as a permanent source of revenue. Such ponds will maintain 600 to 700 fish of eatable size all the year round. They are estimated to provide an annual catch of at least 400 lb of fish valued, in country areas, at approximately £10, while the cost of construction of the pond rarely amounts to £40. It may be mentioned that £10 to £20 is frequently paid as annual rents for good ponds according to size and known fertility.

The chief species of fish cultured in Java are the " Nilem " (*Osteochelus hasselti*), carp (*Cyprinus carpio* var. *floripinnis*) and the " gurame " (*Osphromenus olfax*). Others found include the " tawes " (*Puntius javanicus*) which breeds particularly well, " lebeh " or " keli " (*Clarias bastrachus*), and " gabus " (*Ophiocephalus striatus*).

The first four species mentioned are commonly grown together in the same pond and it is considered in Java that they are not rivals in the matter of food since the carp is a border and bottom feeder, the " nilem " is a surface feeder and the " gurame " is a vegetarian. Little attention is paid to the question of grading the fish according to age and size, which would probably greatly increase the economic value of the ponds as has been proved in Europe.

The Javanese and Malays however, prefer small fish to large because with small fish there is no wastage—consumption being complete—whereas with large fish the bones and other parts cannot be consumed and hence the main market is for smallish fish six to eight inches long such as are harvested from the rice fields. The " gurame " is an exception in that it is usually cultivated until it is one to three lb in weight.

The conformation of ponds is immaterial but most of the artificially made ponds are rectangular, merely a few inches deep where water enters, while the deepest part may be 6 feet in depth and is situated close to the point where excess water overflows. The sides of the ponds are sloped and usually grassed and strengthened by the roots of coconut palms which are frequently planted around the ponds. The ponds are dug so that drainage can be effected easily and the outlet pipe is generally made of the hollowed stem of a palm (*Arenga* sp.) which is first plugged with stones, roots and plant matter. An over-flow is usually also constructed at the top of the embankment above the outlet pipe and to prevent fish from running off through the over-flow a semi-circular barrage of stones, gravel, water plants, brushwood, etc., is usually heaped up and in this simple manner the overflow can be fairly well controlled, even if a few small fish occasionaly pass out. In draining off the ponds, the growth of water plants should not be removed but in putting fry into a pond all large fish should first be removed. At spawning time the spawn is directed into a small off-shoot from the main pond separated from it by a stone and brushwood barrage. In the spawn collecting pond the water is kept about eight to nine inches deep, the bottom is gravelled and shaded and the overflow is passed through several small dispersed bamboo pipes, the mouths near the surface of the water being covered with cloth or fibre to prevent fry (nilem) from escaping. Carp do not spawn on gravel but on plants such as *Eichhornia, Jussieua, Myrophillum,* etc., and these are draped from a bamboo frame so that when eggs are laid, the whole frame can be lifted out and placed in a small hatching pond free of predators, including their own parents.

This small hatching pond may simply be a portion of the main pond fenced off with interlaced bamboo. The carp eggs hatch in three to four days and seven to ten days later the fence is removed, though this is acknowledged to be detrimental since the fry get eaten and also pick up parasites from the larger fish.

The propagation of the " gurame " is easily effected since all that is necessary is to place bundles of fibre (coconut, *Arenga* or other palm or fern leaves) attached to bamboo laths near the outlets from the ponds. The male " gurame " builds the nest and cares for the eggs and fry. The " gurame " is the most expensive fish to cultivate as it takes some years to get it established and of edible size, whereas " nilem " and carp are edible within six

months. "Gurame" is in much demand in the mountain hotels in Java because of its delicate taste and freedom from bones—it is freely compared with trout and salmon.

The "sepat siam" (*Tricopodus leeri*) and the Puyu (*Anabis scandens*) are indigenous in the rice fields of Malaya, are very prolific vegetable feeders and nutritive sources of food, being rich in oil—they are eaten when seven to eight inches, *i.e.*, about six months of age.

The Aruan (*Orphiocephaledus* sp.) is also indigenous in Malayan rice fields, is predadeous on smaller fish, insects, frogs, etc., breeds in shallow water amongst reeds etc., can travel overland for short distances and may weigh one to five lb in weight.

In Malaya, five species of carp are found in cultivation usually mixed in the same pond in fairly constant proportions. They comprise: (1) *Ctenopharnynodon idellus*, (2) *Hypophthalmichthys molitrix*, (3) *H. nobilis*, (4) *Cyprinus carpio* and (5) *Cyprinus* sp.

They are all vegetable and silt feeders, the first one, in particular, being known as to the Chinese as "Chow hu"—the grass eating fish—the second and third live mainly on the half-digested grass voided by the "Chow hu," supplementing this diet by the rich organic bottom silt. The common carp (*C. carpio*) which is bred in Malaya also feeds on organic silt and vegetation and peanut or coconut cake (suspended in the water in a basket) and a little superphosphate is often strewn on the surface of the water of carp ponds. The other carp are imported from China as fry and kept in small ponds until they are about six inches long, each pond 30 x 20 x $1\frac{1}{2}$ feet deep being capable of taking 2,000 fry (1 to $1\frac{1}{4}$ inches long). The fry are fed on wheat flour which is dusted on the water twice daily and in addition they take finely divided grass leaves and several species of duck weed (*Lemma*, *Wolffia*) grown in the pond for the purpose. When they are about six inches long—when they are usually placed in a big pond—they will eat any soft grass, lawn cuttings, etc., in quite substantial quantities, a well-stocked pond 100 x 50 x 3 feet deep requiring about 1 cwt. of grass cuttings daily when the fish are small, increasing to about 3 cwt. when the fish are full size.

The usual proportion of the five species mentioned above are 50 per cent. of No. 1, 20 per cent. of No. 2 and 10 per cent. of each of the others. No. 1 usually shows the greatest rate of growth.

In preparing a new pond it is advisable to mix about two tons of cow manure with the bottom soil so as to assure its neutrality and to accelerate the algal growth and this should be done and the pond filled at least a month before introducing the fish. The water in a carp pond should not be changed or distributed, it being essential to strike a natural balance, physically and chemically, between the fish and the vegetation—the waste of the grass-eating carp (in curved lengths of one to four inches) becoming the food of the other species and stimulating algal growth which in turn aerates the water. The average temperature of a carp pond in Malaya at one foot below the surface is 87°F. In feeding grass to the carp it should be placed within a floating bamboo frame and fixed at one side of the pond to prevent the grass being scattered all over the pond. Guinea grass has been found to be a good feed, as well as maize leaves, fleshy banana stems, water hyacinth, 'dalo' and 'kumala' leaves, &c.

There will always be losses in fish culture approximating to 30 per cent. but most of the losses are in the young stages and generally due to over crowding—a good criterion (assuming a pond 100 x 50 x 3 feet deep) is 50 square feet of surface area for each fish of three to four lb and thinning should be done accordingly at intervals, say, when the fish are ten inches

long and again at about nine months after stocking the pond, leaving a hundred fish of about four lb each after the end of twelve months. In the rice areas in Malaya, especially the coastal flat areas, after supplying an abundance of good food the surplus of fish sold by the rice growers is generally reckoned as being sufficient to pay the land rent and water rate and often the returns from the fish are of greater value than the surplus padi, after domestic stocks have been stored. Thus, the value of fish culture, is apparent since once established it demands little labour, and it is hoped that it may be possible to initiate fresh water fish culture in Fiji in the near future with local, if not with inported fish species.

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THE VITAMIN C VALUES OF SOME FIJI FRUITS AND VEGETABLES.

By
W. J. BLACKIE, M.Sc., F.I.C., F.N.Z.I.C.,
Senior Chemist.

THE vitamin C values of certain Fiji fruits and vegetables have been determined and the results are recorded in Table (I).

The vitamin C was determined by the Tillman's method (1) using the modification of Bessey and King (2). In this method the ascorbic acid is extracted with a solution of 8 per cent. acetic acid and 2 per cent. metaphosphoric acid, the liberation of the vitamin being facilitated by grinding in sand. The centifuged extract is then titrated with the oxidation reduction indicator 2:6 dichlorophenol indo-phenol standardised against synthetic vitamin C.

TABLE I.

Foodstuff.	Scientific Name.	Fiji value.	Recorded values.
Orange (juice)	*Citrus aurantium*	70·4	0·9 to 70·5
Lime (juice)	*Citrus acida*	48·9	16·8 to 68·1
Grape fruit (juice)	*Citrus grandis*	36·3	26·0 to 65·0
Lemon (juice)	*Citrus limonum*	24·5	14 to 70·9
Pineapple (juice)	*Ananas sativus*	55·4	5·9 to 75·9
Tomato (juice)	*Lycopersicum esculentum*	28·8	9·2 to 40·0
Soursop (juice)	*Annona muricata*	22·1	46 to 62·0
Mango	*Mangifera indica*	82·2	13·0 to 103·0
Pawpaw	*Carica papaya*	37·4	43·0 to 150·0
Tomato	*Lycopersicum esculentum*	21·6	12·9 to 39·0
Soursop (edible portion)	*Annona muricata*	15·3	not recorded.
Lettuce	*Lactuca sativa*	4·3	0·5 to 22·0
White turnip	*Brassica rapa*	7·2	17 to 34
China cabbage	*Brassica chinensis*	4·1	not recorded.
Cucumber	*Cucumis sativus*	2·8	1·0 to 11·8
Chokos	*Sechium edule*	0·8	not recorded.

In column 3 of the table are included the average Fiji values determined in this investigation expressed as milligrams of vitamin C per 100 grams of the foodstuff or as milligrams of vitamin C per 100 cubic centimetres of the juice in the case of expressed juice.

In the fourth column of the table are included corresponding maximum and minimum value recorded in other countries as compiled by Fixen and Roscoe(3).

It will be observed that Fiji values compare very favourably with values recorded in other countries and that in general the average figures lie between the maximum and minimum values recorded in columns 4 of Table I. Particularly noteworthy is the high value obtained for pineapple juice, lime and mango. Fiji grown tomatoes also give good average values.

The exact daily amount of vitamin C required for perfect health is not known with certainty, but Hess (4) from experimental work believes that protection against scurvy can be secured by the ingestion of 2·5 milligrams of vitamin C for a child and 7·5 milligrams for an adult.

The amounts required for perfect health are probably somewhat greater than these quantities and from the figures quoted in Table I, it is believed that adequate protection could be secured by the daily ingestion of the quantities indicated in Table II, assuming that the daily requirement of an adult is 10 milligrams and of a child 3·3 milligrams.

TABLE II.

Foodstuff.	Adult. Protective quantity.	Child. Protective quantity.
	oz.	oz.
Orange (juice)	0·49	0·17
Lime (juice)	0·70	0·24
Grapefruit (juice)	1·05	0·35
Lemon (juice)	1·40	0·47
Pineapple (juice)	0·63	0·21
Tomato (juice)	1·23	0·41
Soursop (juice)	1·58	0·53
Mango	0·42	0·14
Pawpaw	1·03	0·35
Tomato	1·58	0·53
Soursop (edible portion)	2·35	0·79
Lettuce	8·77	2·93
White turnip	5·01	1·67
China Cabbage	8·77	2·93
Cucumber	11·67	3·89
Chokos	43·85	14·62

It is necessary to point out, however, that experimental work has shown wide individual variation in requirement, due to several causes including poor absorption in the gastrointestinal tracts of certain individuals and diseases. The table therefore must be considered as a general guide only, to be implemented by medical advice in certain cases.

SUMMARY.

(1) The vitamin C content of certain common Fiji fruits and vegetables are recorded.

(2) The values determined for fruits and vegetables grown under Fiji conditions are in the same order and compare favourably with similar products produced in other countries.

(3) The quantities of Fiji fruits and vegetables required for adequate protection against scurvy are tabulated.

(4) Under proper food habits Vitamin C deficiency should not exist in Fiji.

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FIJIAN FARMERS' CO-OPERATIVE MARKET AT NAUSORI.

By
B. E. V. PARHAM, M.A.,
Agricultural Officer, Southern.

In October, 1937, a representative meeting of independent Fijian farmers met at Naduruloulou to discuss agricultural development in the Southern Agricultural Division. Exempted Fijians from twenty-eight districts in the Province of Naitasiri, Tailevu, Rewa and Namosi were present at this meeting.

Among a number of useful practical resolutions adopted at this meeting was one agreeing to the erection of a co-operative market building at Nausori for the organised sale of produce.

The Department of Agriculture was asked to support the scheme and in September, 1939, largely as a result of the valuable co-operation of the then District Commissioner Southern (Mr. A. J. Armstrong), the approval of the Nausori Town Board was obtained to the proposal. The Board agreed to the erection of a semi-permanent building with concrete foundations and accepted, with a few amendments, the plan prepared by Native Field Assistant Sailosi of the Department of Agriculture. The Board also granted an excellent central site.

A representative Committee was immediately appointed to undertake the collection of funds and the organization of labour to erect the building.

A start was made late in December, 1939, and the building was completed on 20th January, 1940. The structure is fifty feet long and eighteen feet wide with concrete floor. The walls, which stand on dwarf concrete walls, are ten feet high with a continuous wire-covered opening four feet in width for ventilation. The building was, of necessity, roofed with corrugated iron as asbestos roofing material was unobtainable. The outside of the building has been painted a cream colour with brown facings. Inside, an office and store-room have been provided and the main part of the building has been fitted with shelves for fruit and other produce. A supply of water was also added.

The Committee showed commendable ability in organizing the actual work of construction. Two farmers with a knowledge of carpentry were appointed to work under the general direction of Native Field Assistant Sailosi. These men were assisted by a team drawn from the Provinces of Naitasiri and Rewa, while the farmers resident in Tailevu South undertook to provide food for the workers. By the courtesy of the Principal, Davuilevu Teachers' Training Institute, accommodation for these men was found at Davuilevu. The arrangements provided an interesting example of co-operative effort and resulted in a limitation of expenditure to the actual cost of materials.

The building was formally opened on 20th January by the Adviser on Native Affairs (Hon. H. C. Monckton) in the presence of a representative gathering of Indian, Fijian and European residents.

Amongst those present were the Director of Agriculture; the District Commissioner Southern; the Manager, Colonial Sugar Refining Company Limited; Hon. K. B. Singh, M.L.C.; the Senior Agricultural Officer; the Senior Cane Inspector, C.S.R. Co. Ltd.; the Accountant, Department of Agriculture; Revds. R. Green and A. Blackett of Davuilevu; the Manager, Messrs. Morris Hedstrom Ltd., Nausori; the Manager, Messrs. Wing Zoing Wah & Co.; Messrs. Ross; Rambissesar; the Agricultural Officer Southern and a number of leading members of the Fijian Community.

After the ceremonial welcome and the presentation of the tabua and yaqona and the chanting of the yaqona meke by the men of Naila, the Chairman of the Committee, Manasa B. Tauca, presented an address of welcome to the Adviser on Native Affairs who then addressed the gathering. He indicated the pleasure with which he viewed the efforts of Fijian smallholders and exempted farmers to improve their circumstances, while still remaining loyal to their time-honoured customs and social obligations.

He urged the importance of proper utilization of the land and stressed the necessity of careful control of the market by means of regulations aiming at the orderly and efficient maintenance of the co-operative effort which the members had undertaken.

Exempted men had considerable responsibility in the way of maintaining a reasonable standard of living for themselves and their dependents and the market scheme would enable them to dispose of their surplus crops at a profit. It was most desirable that whatever their success as individuals might be, they should always have regard for the natural ties with the Fijian community as a whole. The market would serve as a centre for exempted Fijians and would enable them to send in their produce for sale, without leaving their holdings more often than necessary. The building would also be useful for such purposes as District Agricultural Shows and other gatherings of a similar nature. In declaring the building open, the speaker emphasized his interest in the possibilities of the undertaking and his hopes for a very successful and useful future.

The Director of Agriculture said he regarded it as a privilege to be present and that he was glad to see many familiar faces. He congratulated them on the excellent site they had obtained and on the splendid building erected so economically by their own labour. The building afforded ample evidence of progress in their desire to express their own individualities as peasant farmers and the market provided a necessary service to the community. He was glad that produce sold in the market would compete with produce sold by others, and stressed the need for maintaining good quality and fair prices and that it was essential to give no credit, in order to compete successfully with others. He said that the Department was anxious to assist as much as possible, because it was realised that the peasant farmers were the backbone of this country as of every other agricultural country. He stressed the practical assistance already rendered by Agricultural Officers and by Native Field Assistants. He pointed out that exempt men must learn to shoulder their responsibilities, if they were to make headway as farmers. That their responsibilities were threefold: firstly, they had their responsibilities towards their own families to ensure the provision of adequate shelter, abundant and varied food and sound sanitary conditions; secondly, they had their responsibilities towards their race and their country, in that they must show respect to their chiefs and show their love of their country by its better utilisation, which involved conservation of the good top soil, rotation croping, composting and the fuller use of animals in husbandry; thirdly, they had their responsibilities to the Government, which meant that they should show their loyalty in every way as good law abiding citizens, paying taxes when due, producing more of the necessary products which can be grown in the Colony and thus reducing the big annual bill that is paid outside the Colony for imported foodstuffs.

He concluded by adjuring them to aim at improving their standards of living, rather than amassing wealth, at diversification of crops and a better use of cattle, pigs and poultry and wished them a very successful and permanent future.

A quantity of produce was exhibited for sale having been donated by growers—the proceeds to go towards the cost of the building.

At the time of writing, the scheme has been operating for a little over a month and the amount of produce handled has been large.

A market caretaker, an ex-student from Central Agricultural Station, has been appointed by the Committee which has undertaken to arrange for the payment of his salary. He has already done good work in organising the supply and disposal of all produce sent in.

The number of Fijians contributing to the scheme approximately 200 and a scale of commission charges has been tentatively fixed. Members who leave their produce to be sold are charged 5 per cent. commission on sales; and non-members, seeking the same service, pay 10 per cent. A small charge is also made for space occupied by those who elect to bring in and sell their own produce.

The successful completion of the undertaking has been due to the energy of the Committee and to the far-reaching personal contact which has been maintained by the Native Field Staff of the Department with exempted men in all parts of the area.

The scheme has been marked throughout by a spirit of co-operation and confidence between individuals from widely scattered districts and by an obvious confidence in the guidance of the Agricultural Department in all affairs relating to the well being of the farming community.

The Committee has also acknowledged its indebtedness to the Nausori Town Board, the Town Overseer and the Methodist Mission Authorities for the assistance which has been given.

FIJIAN INDEPENDENT FARMERS IN THE PROVINCE OF CAKAUDROVE.

By

L. W. HARWOOD, H.D.A.,

Agricultural Officer, North.

At the Annual Show held in Suva on the 16th October, 1939, a map of Viti Levu showing the location of Fijians exempted from communal duties aroused considerable interest. These notes on the work being done by similar men in a much less known part of the Colony serve to indicate that the desire to become a successful farmer is not confined to Viti Levu alone.

In analysing the activities of these farmers and comparing them with those of similar men on Viti Levu, one must not forget that there is no circuminsular road on Vanua Levu and that distance and inaccessibility of markets, high freight costs, inferior communications and the high cost of goods, all contribute to make the path of the independent Fijian farmer a hard and thorny one. It speaks well for the pertinacity and courage of these men that they have done so well and it is most encouraging to see how they appreciate regular visits of inspection by the Native Field Assistants of the Department of Agriculture.

The area selected for review is made up of the islands of Taveuni, Qamea and that portion of Cakaudrove bordering on Natewa Bay and Buca Bay. In this section of the Division, which is supervised by the Native Field Assistant stationed at Taveuni, there are fifty-five men who have been exempted from communal duties. These men vary much in type, educated and uneducated, men of rank and of lowly birth, but all are imbued with the one desire to establish themselves as independent peasant farmers.

In comparison with other parts of the Northern Division, the selected area is fortunate in its soil type. The fertility of the island of Taveuni is well known, the rich deep soils encouraging a diversity of crops. Despite the high rainfall in parts of the island, there is little evidence of soil erosion, owing to natural vegetative cover and porosity. In the Vanua Levu section, soils vary from almost pure coral sand to deep rich alluvial loams on the creek banks and equally rich colluvials in the small sheltered valleys, but unfortunately, there are also poor red soils. In some places the forest growth is heavy. The sea coast is fringed by groves of coconuts upon which the natives in these areas are so dependent.

A pleasing feature of these farmers is that the majority of them have definite titles to their holdings. It is desirable that every exempted man should not only live on his own land, but that he should have security of tenure. Agricultural effort in Fiji, and especially in this Division, appears to be appreciably retarded by the prevalence of annual tenancies and short term leases, and hence, the farmer, naturally enough, does not attempt to establish permanent crops or make other permanent improvements. An analysis of the figures obtained in this part of the Division show that forty-one farmers are living on their own lands, six on Mataqali lands, and the remaining eight are farming their own lands but still occupy houses in their villages. The latter have been advised that until such time as they are actually living on their own lands, they are liable to be called upon by the "Buli" to perform communal labour. Those who do not possess definite titles to their blocks of land have been advised to apply for native occupancy leases, which give them security of tenure for ten years.

At the time of writing the majority of the farmers are engaged in building their own houses on their farms and the food crops position appears to be quite satisfactory as portrayed in the summary given below, which also indicates that the independent Fijian peasant farmer of Cakaudrove is comparatively well fed. His main food crops are 'dalo' (*Colocasis antiquorum*), yams (*Dioscorea* spp.), tapioca, 'kawai' (*Dioscorea* spp.), plantains, bananas, pineapples and kumalas (*Ipomœa batatas*), whilst small plots of pawpaws, sugar cane, native vegetables, maize, and odd citrus trees are grown as well as coconuts which form an important item in the diet.

SUMMARY OF FOOD CROPS GROWN.

Crop.	*Total area or No. planted.*	*Average area or No. planted.*
Dalo	45·5 acres	·81 acres.
Yams	6·8 ,,	·12 ,,
Kawais	1,063 mounds.	19 mounds.
Plantains	15·7 acres.	·28 acres.
Tapioca	4·3 ,,	·08 ,,
Pineapples	5·6 ,,	·10 ,,
Kumalas	8,590 mounds.	156 mounds.

The above crops, together with jungle fruits, fish and occasionally pork, provide a moderately varied and bountiful supply of food; recently European vegetables have been introduced, including various beans, onions and cabbage, while the keeping of more milch cows is also being encouraged as a valuable improvement to the diet.

Tapioca does not form as important part of the diet as it does in the drier parts of the Division, and the sturdiness of the natives would indicate that the food value of 'dalo' is considerable.

When one considers the question of money crops it becomes readily apparent that, through force of circumstances, the Fijian farmer in Cakaudrove has had to regard his permanent crop, the coconut, as his principal source of money, and although this has meant that there is little or no diversification of cash crops, it has the effect of anchoring him to the land, and assures him an annual income sufficient for his necessary purchases, which are few in number.

Practicaly none of these men have any capital, and they do not possess ploughs or any other cultural implements except the usual fork and cane knife, so that crops like rice, maize and cotton have not been grown to any extent.

The only other money crop of any consequence is 'yaqona' (*Piper methysticum*) and the 55 farmers have an area of 8·6 acres of this crop, an average of ·16 acre per man. This is a very profitable crop for the Fijian and is being encouraged.

In other parts of the Colony it is necessary to stimulate the planting of permanent crops to sustain the efforts of the farmer, and although this Division has many difficulties, the settlement of exempted men is greatly facilitated by the fact that a large number of Fijians have mature coconut palms growing on their own land. The estimated area owned by these men is 836 acres, an average of fifteen acres per man, which should give the farmer about four tons of copra per annum. It is clear that the exempted man of Cakaudrove realises his absolute dependence on the coconut, when it is seen that approximately fifty-five acres of coconuts have been planted to date in 1939, an average of one acre per man. Other permanent crops include breadfruit, avocado and citrus, but these are not grown in any quantity. It is realised that other permanent crops must be established and nurseries of rubber, cocoa and coffee will be established as seed becomes available.

Although insufficient importance is as yet placed on the value of stock, the peasant farmers all appear to keep some animals, whether for commercial or for their own use. The Fijian is learning that he must keep poultry and that the pig is a very valuable animal. The livestock owned by these farmers consists of thirteen hundred poultry, thirty-six horses, sixty-five cattle, thirty-five pigs and a few geese.

The activities of these men are not restricted to farming. Two of them in the Vuna district of Taveuni are progressive retail storekeepers who make regular shipments of copra to Levuka. The fact that fifty per cent. of these farmers own their own drying "vatas" also indicates that they are not content to sell their "green copra" but prefer to dry it for themselves. Nine of these men own and operate "smoker" kilns which unfortunately turn out copra of indifferent quality.

These notes have been compiled to show that even in outlying parts of the Colony many of the Fijians are striving to take their place as farmers. What they have done, with limited supervision and advice, is astounding when one considers the many difficulties which confront them. Hence, it is most encouraging to feel that the native of this Colony is desirous of doing his utmost to become a valuable contributor to the agricultural assets of Fiji.

PRELIMINARY TESTS ON THE SEASONING OF KAURI.

By

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Conservator of Forests.

THE common occurrence of any species of timber in any part of the world is usually enough to encourage its local use and, as a consequence, within a very few years, the extent to which such a timber is useful or useless becomes fairly well known. In this respect kauri (*Agathis vitiensis*) occupies a strange position: the writer has heard opinions on it varying from those who will use it for nearly every purpose to those who avoid it in all circumstances.

Now it is obviously impossible to pass final judgment on kauri without observing it in actual use over a number of years, but it is not difficult to carry out rough tests to see whether it is being correctly used, in at least one direction, in the first place.

With very few exceptions no reliance can be placed on the behaviour of a timber unless it has been properly seasoned before being put into use. An opportunity was therefore taken of carrying out rough seasoning tests on a consignment of a little over one ton of "O.B."* kauri boards cut in September, 1939.

Before discussing the results of these tests, however, it may be as well to examine the meaning of the term "seasoning."

A newly-felled tree contains large quantities of water most of which must be removed before the timber is fit for use. Seasoning is the process whereby the water is removed.

Wood is not, however, a homogeneous solid, like iron, but it is built up of a vast number of small tube-like units or cells. In the living tree most of these cells are filled with liquids but it is important to recognize the fact, for a reason that will appear later, that moisture also exists in an absorbed state in the cell walls. In conifers (of which kauri is one) the sapwood may contain moisture up to nearly 200 per cent. of its dry weight while the moisture content of the heartwood may be only about 50 per cent. There is thus a very considerable amount of water to be removed before the timber can be put into use.

As timber dries, the free water within the cells is the first to evaporate and not until this has been almost completely lost is the absorbed water in the cell walls released. The point at which little or no free water is left is known as the fibre saturation point and until this stage is reached no significant shrinkage occurs, although by then the greater part of the water may have been removed and the moisture-content reduced to about 25 to 30 per cent.

This, however, is not enough for ordinary purposes. If it is to prove satisfactory in use timber must be dried to an extent where it will be in equilibrium with its surroundings, which is to say that in the wet zones wood for use indoors should be dried to a moisture-content of about 12 to 15 per cent. and for use outdoors to about 18 to 20 per cent. The importance of this final drying can be clearly seen from the experiment under discussion which may now be briefly described.

"O.B.", or Ordinary Building, a grade in common use in the Colony. Its limits are somewhat elastic but, in general, it is applied to timber free from shakes, splits, knots, &c., but in which an unlimited proportion of sapwood is permitted.

Nine groups, each containing six similar planks, were stacked in a well ventilated room. On three occasions, at intervals of two months, each plank was weighed and its dimension, at pre-determined points, recorded. A summary of the results is as follows:—

TABLE I.—WEIGHTS.

Group No.	Average dimensions.	Volume cub. ft.	Weights in lb on			Weights in lb per cub. ft. on		
			29/9/39	17/11/39	26/1/40	29/9/39	17/11/39	26/1/40
1	10″x 8″x 1″ ..	3·80	162	126	126	43	33	33
2	10″x 10″x 1″ ..	4·33	176	146	142	41	34	33
3	10″x 12″x 1″ ..	4·60	176	153	153	38	33	33
4	10″x 8″x 1½″ ..	5·49	281	160	149	51	29	27
5	10″x 10″x 1½″ ..	6·36	296	184	173	47	29	27
6	10″x 12″x 1½″ ..	8·16	365	266	251	45	33	31
7	10″x 8″x 2″ ..	7·29	317	229	213	43	31	29
8	10″x 10″x 2″ ..	8·85	398	269	252	45	30	28
9	10″x 12″x 2″ ..	10·81	577	327	287	53	30	27
	Total ..	58·69	2,748	1,860	1,746	....	....	....
	Differences lbs.			888	114	....	..	..
	Averages per cubic foot					47	32	30

TABLE II.—WIDTHS.

Group No.	Aggregate widths in feet on*			Shrinkage during periods.	
	29/9/39 A.	17/11/39 B.	26/1/40 C.	A–B per cent.	A–C per cent.
1	12·78	11·94	11·85	2·0	2·7
2	15·08	14·84	14·78	1·6	2·0
3	15·03	14·75	14·70	1·9	2·2
4	12·21	12·06	11·91	1·2	2·5
5	15·13	14·96	14·80	1·1	2·2
6	18·10	17·84	17·63	1·4	2·6
7	12·15	12·02	11·87	1·0	2·3
8	15·09	15·03	14·88	0·4	1·4
9	18·16	18·02	17·69	0·8	2·6
			Average ..	1·3	2·3

* This figure is the sum of 3 measurements on each of 6 planks, *i.e.*, the sum of 18 widths.

The first point of interest concerns the loss in weight. (Table I). It will be observed that the total weight of the consignment was successively 2,748 lb, 1,860 lb and 1,746 lb. In the period 29/9/39 to 17/11/39 (49 days) 888 lb of water were evaporated whilst only 114 lb were lost in the following period from 17/11/39 to 26/1/40 (69 days). During the whole period the total loss of weight was 1,002 lb or 36 per cent. of the whole.

The final weights have been reduced from an average of 47 lb per cubic foot to 30 lb per cubic foot, the variations through the groups (from 33 to 27 lb per cubic foot) being almost certainly due to the varying proportions of sapwood which they contained.

In order to determine the degree of seasoning which the timber had reached at the conclusion of the experiment the Senior Chemist of the Department of Agriculture, kindly undertook moisture determinations of representative

samples. From his investigations it appeared that the moisture content had been reduced to values between 11 and 13 per cent., and that the oven-dry weights (*i.e.*, the weights of perfectly dry timber) varied from 24 to 30 lb per cubic foot. The significance of these figures is discussed under the title "Local Applications" later in this note.

Turning now to shrinkage (Table II) it will be seen that the average shrinkage in width throughout the time of the test was 2·3 per cent. or rather more than 7/32 inches for a 10-inch plank. But during the first period, in which the timber lost 888 lb in weight, the skrinkage was only 1·3 per cent.: the loss of a further 114 lb during the second period was responsible for raising the shrinkage from 1·3 to 2·3 per cent. This characteristic acceleration of the rate of shrinkage after the fibre saturation point is passed can be seen still more clearly from the individual figures in the table. Thus whilst the planks in group 1 lost no weight in the second period (though the degree of approximation adopted may involve a maximum error of $1\frac{1}{2}$ lb per cubic foot) the shrinkage figure rose from 2·0 to 2·7 per cent. Similarly in group 4 the loss of only 2 lb of water per cubic foot during the second period was accompanied by a shrinkage increase from 1·2 to 2·5 per cent. The final stage in the seasoning process is thus seen to be of major importance particularly where the timber is to be used for first class joinery work or, in fact, for any purpose where subsequent variation in dimensions cannot be tolerated.

It may be noted in passing that, despite its local reputation, kauri possesses by no means an exceptional tendency to shrink and it may easily be found in due course that many other local timbers exceed it in this respect.

It will have been observed that shrinkage has been discussed here only with regard to its effect on width. Longitudinal shrinkage (along the grain) is small and is of no practical importance: radial shrinkage is usually about half that in a tangential direction with the consequence that shrinkages in thickness may be proportionately either more or less than those in width depending upon the method of sawing adopted. Since width is the more important dimension there are advantages in radial sawn (*i.e.*, "quarter sawn") material over that sawn tangentially (*i.e.*, "flat sawn"); incidentally for flooring quarter sawn boards are preferred because of the better wear-resisting qualities of "edge-grain."

Before concluding it may be as well to point out that though the experiment described has of necessity, dealt only with the measurable properties of weight and shrinkage, stability in these qualities is not the only result aimed at in seasoning. Other advantages are numerous. One of the most important is a reduced susceptibility to fungus attack. A condition essential to decay is sufficient moisture, and timber dried below 20 per cent. is immune from attack provided it is not subsequently exposed to damp conditions. Knowledge of this indicates that much damage in buildings can be avoided if seasoned timber is used and provision for adequate ventilation made. Many insects do extensive damage in moist timber but are unable to exist in seasoned wood, though there are, it must be admitted, some insects, notably the *Lyctus* beetles, which attack only seasoned timber and protection from them calls for special precautions.

An increase in strength, which may be as much as 50 per cent., is also to be expected from seasoning. In addition, paint cannot be applied satisfactorily to wood which is not thoroughly dry nor will oily preservatives of the creosote type be effectively absorbed by a timber which is wet. The feature of weight reduction has already been referred to. This may be of

considerable importance where freight is an expensive item. In the consignment under discussion, for example, what was finally only 1,746 lb of timber was accompanied by no less than 1,002 lb of quite useless water!

Local Applications.

The question may now be asked, how can the figures discussed in this note be applied by the users of the two million-odd superficial feet of kauri produced annually in this Colony? By reason of the fact that no two planks in any consignment are likely to have identical degrees of moisture, complicated or exact methods of testing are ruled out even if they were readily available—which is not the case. The writer suggests, however, that in view of the common practice of selling green timber it might be well if the prospective user weighed and measured a few typical samples of the timber he buys if he intends to use it immediately. This method is undoubtedly a crude one but is capable, at least, of indicating whether or not the timber is fit for use. For example, it has already been stated that the oven-dry weight of kauri varies between 24 and 30 lb per cubic foot. If, therefore, a moisture-content of 20 per cent. is acceptable for building purposes any kauri weighing more than 36 lb per cubic foot contains more than the permissible degree of moisture, and even figures approximating to 36 lb per cubic foot should be regarded with suspicion if the timber contains much sapwood. Reference to Table I, Column 7, shows that even the crude method suggested here would have been sufficient to reject the whole of the consignment under test since, with one exception, the weights of timber are a long way above the limit laid down. Yet, it is to be noted, this consignment is typical of much timber put into buildings in the Colony.

Something more, however, can be done to improve current practice in the erection of buildings in which Fijian timbers are used. During a spell of dry weather much good will result from getting all the timber required, preferably sawn to approximately the correct thicknesses, on to the site as soon as the latter is cleared. It should then be properly stacked and spaced with well-sawn dry "stickers." A temporary roof over the stacks will also prove to be a good investment. For panellings, furniture and finishings generally, better arrangements should be made for seasoning if defects and blemishes are to be avoided.

In conclusion, the writer would be glad to supply to anyone interested, such information applicable to local conditions as is available on application to him at the Forest Department.

REVIEW.

MALAYAN PINEAPPLES.

The Malayan pineapple industry continues to flourish. The average area under cultivation in the last three years being 72,000 acres and the average export, 76,000 tons of canned products. Of the total export, 72 per cent. goes to the United Kingdom and 20 per cent. to other parts of the Empire. All pineapple factories are registered and the growers are paid a fixed price for their fruit based on the price of the canned product. All packers are obliged to carry out grading and marking by regulations.

There are now two strictly regulated grades—Golden and Standard— and packs that do not attain to these grade requirements are not allowed to use the Malayan Mark.

General control is effected by a Control Board which has functioned successfully in improving prices in 1939 compared with the three proceeding years by the allocation of quotas to producers. —H.W.J.

(*Queensland Producer*, Vol. 21, No. 29, Jan., 1940.)

ENTOMOLOGICAL NOTES.

By

R. J. A. W. Lever, B.Sc., D.I.C., A.I.C.T.A., F.L.S.

1. THE JASSID LEAF-HOPPER OF COTTON.

In practically every part of the world where cotton is grown some damage to the leaves is occasioned by the attacks of small active bugs known as Jassids, cotton fleas or leaf-hoppers. The feeding is usually done on the lower surface of the leaves which in consequence have a puckered, crinkled appearance, resulting in a lowered vitality expressed in a decrease in lint yield or by actual boll-shedding,

In 1922 two fairly detailed articles (1), (2), on local cotton insects did not refer to Jassids nor did subsequent ones in 1923 and 1924 (3), (4), although they included references to rubbish-feeders admitted as being "probably harmless." Next year a visit was paid to Fiji by the then Director of Cotton Culture in Queensland—Mr. (now Sir) Geoffrey Evans—but his report (5) similarly made no mention of Jassids, from which one may conclude that they were of no economic importance although they may be assumed to be indigenous insects which came in from wild jungle plants when cotton was grown on a fairly big scale.

However, shortly after the appointment of a Cotton Specialist in 1926, the occurrence of a small yellow leaf-hopper was noted (6) with the remark that one or two of the New Guinea kidney hybrids appeared to be resistant to leaf-curl. Specimens sent to the Imperial Bureau of Entomology, London, were indentified as an undescribed species of *Empoasca*. Subsquent references stated this pest was worst in the wet season (January till April), sometimes delaying ripening up to two months more than usual before the pest disappeared with the onset of dry weather in May or June. This is the usual cycle in the Colony and the damage in the early part of the year, when severe, is such a shock to the young plant that it may never fully recover.

In 1931, just prior to his departure from Fiji for the British Solomon Islands Protectorate, the present writer collected further specimens at Sigatoka for dispatch to London, but nothing further was heard of them. As reports of this pest were still being received in 1938, it was decided to pursue the matter and insects were collected on cotton at Sigatoka again and also at Doboilevu and specimens were kindly sent from Lautoka by the then Agriculturel Officer, North. However, the Jassid is still only generically identified as *Empoasca* despite its being sent to a world authority on these insects.

It is interesting to note that this genus probably occurs in New Guinea (7), certainly in the Marquesas and Hawaii, but is absent from Samoa (8).

Life-history studies have not been made as, being a very delicate insect, it does not easily stand the journey from the cotton-growing areas to Suva and its extremely active habits (as expressed in its popular name of cotton-flea) make it a difficult subject to catch in the field in the large numbers required for bionomic work. Studies therefore must be made in the cotton growing area.

It may be described shortly as an orange-yellow Jassid, 3 mm. in length with two black spots on each fore wing which is barred near the apex with a dark band.

In parts of South Africa, great success has been reached by breeding resistant or nearly immune strains of cotton whose hairy leaves so repel these minute insects that their delicate bodies and mouth-parts are aggravated sufficiently to inhibit their feeding. In Fiji, the Peruvian Tanguis is found

to be most resistant, followed by the New Guinea kidney hybrids, Back Cross No. 172, with Sea Island as the most susceptible variety.

When attack is bad, spraying with Bordeaux mixture alone or mixed with nicotine sulphate—10 fluid ounces (½ pint) in 50 gallons of water – is a general control in other cotton regions.

This article was written some eighteen months ago but has been held back pending specific identification which cannot now be expected from London for some time.

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*Erroneously numbered Vol. 4 and never corrected.
†Erroneously numbered Vol. 5 and never corrected.

2. THE CORN EAR WORM OF MAIZE.

(*Heliothis armigera* (Hbn.)).

In 1921 caterpillars of the corn earworm were recorded (1) damaging Para grass and four years later Simmonds (2) listed it as a pest of tomato leaves - this insect is also called the cotton boll worm, tomato fruit-worm and tobacco bud-worm. In 1939 it was found by the present writer destroying growing maize cobs—this with cotton bolls are its chief food-plants in other parts of the world. It is almost certain that this last entry was from commercial seed maize imported from New South Wales in September, 1939. Although calcium arsenate is normally recommended for control, spraying with this at the rate of 1½ lb in 40 gallons of water, scorched the leaves and it is necessary either to add lime in equal parts or to spray instead with lead arsenate at the rate of 1½ lb to 40 gallons of water, or to use it simply as a dust with or without hydrated lime aiming at 4 lb per acre.

The worst aspect of this fresh entry of *Heliothis armigera* (Hbn.) is its liability to spread to cotton from adjacent maize, tomatoes or grass weeds. Abandoning land to weeds when it has been cropped with cotton is potentially dangerous as it encourages corn earworm caterpillars (4) which came originally from North America but are now very widespread.

Instead of the spray recommended above, it may be more convenient to apply by flipping with a large whitewash brush, the following solution:—

½ lb lead arsenate and 1 gallon of molasses, each mixed first in water and and then added to each other and finally made up to 6 gallons of water.

Although a species of *Apanteles* wasp was recorded as a pest of *Heliothis* caterpillars in 1925 (3), this is unlikely to be a very effective control and early steps should be made to use some insecticide coupled with the choice of a fairly resistant variety of early maturing maize such as Improved Yellow Dent. Fortunately this insect has distinct liking for only one crop, the maize "race" not feeding normally on cotton and *vice versa*.

The hornet *Polistes macæniss* F., was seen to be acting as a predator on larvæ in the field in October, 1939, but this also cannot be relied upon as a real check. Resistant varieties seem most hopeful as even on citrus the caterpillars bore into the buds and are difficult to kill with sprays (6).

In maize the eggs are usually laid on the tassel of male flowers and less often on the flower-buds or leaves. Eggs are not laid in large numbers till extrusion of tassels: this crop being the preferred one may be used to direct damage from cotton (7),

The caterpillar varies in colour from pale green to dark brown with a series of longitudinal stripes. After feeding on the silk it later crawls under the husk and eats the tender grains where it is well protected from insecticides. A whole ear may be practically consumed by one caterpillar which tunnels throughout the cob which is soon a mass of rotting tissue. When full grown, the caterpillar measures $1\frac{1}{2}$ inches and usually drops to the ground to pupate but may do so within the cob. This habit is said by Wolcott (5) not to occur in the West Indies where the caterpillar is stated never to pupate in the ear though found occasionally to do so in Fiji by the present writer. The moth is yellowish-brown with a black patch on the outer margin of the wing: the expanse is $1\frac{1}{8}$ inches and the body about $\frac{3}{4}$ inch in length.

(1) Simmonds, H. W., 1921. *Agricultural Circular*, Vol. 2, No. 5. October–December.
(2) Simmonds, H. W., 1926. *Council Paper* No. 36, Legislative Council, Fiji. (For 1925).
(3) Simmonds, H. W., 1932. Annual Bulletin Divisional Reports, Fiji. (For 1931).
(4) Queensland *Agricultural Journal*, 1939; Vol. LII, Part 4, October.
(5) Wolcott, G., 1933. "An Economic Entomology of the West Indies."
(6) Parry Jones, E., 1936. Maize Citrus Expt. Station. Publication No. 4A.
(7) Parsons, F. S., 1939. *Bull. Entom. Resch.*, Vol. 30, Pt. 3, November.

3. OVERSEAS INSECTS INTERCEPTED AT SUVA, 1939.

THE need for the constant vigilance that is maintained by the Produce Inspection Division, is proved by the following notes on live insects that were intercepted last year by the Inspector of Produce and other officers and forwarded to the writer in some stage of development.

In May, 1939, a consignment of cowpea, *Vigna* and broad beans, *Vicia*, forwarded by the Department of Agriculture, Cyprus, was found to have two species of *Bruchus*, the so-called pea and bean "weevils." These are not true beaked weevils but are related to the leaf-eating or leaf-mining beetles. The smaller was identified by the Imperial Institute of Entomology as *B. analis* F., boring in peas, and *B. pisorum* L., the larger, tunnelling within broad beans. The whole lot of seeds was thoroughly fumigated with carbon bisulphide by the Inspector of Produce but they had been previously so badly bored as to be of little value for sowing.

The Agricultural Officer, South, forwarded early in October some dwarf beans (*Phaseolus*) from the Department of Agriculture, New South Wales, which were bored by another pea or bean "weevil." Through the kindness of Mr. Tonnoir of Canberra, this was identified as *Bruchidius obtectus* (Say). Control measures recommended by the writer were fumigation, storing with flaked naphthalene or air-slaked lime.

Lastly, the Senior Veterinary Officer found similar beetles in some seeds of the legume *Desmanthus virgatus* imported towards the end of October from the University of Hawaii, Honolulu. This was kindly determined by Dr. Zimmerman of the Bishop Museum as *Bruchus pruininus* Horn. the fourth species to arrive in seeds within a period of six months.

Some mango seeds (fibrous kernels) imported from India in July were found to contain numbers of the true mango weevil *Cryptorhynchus mangiferæ* F. which is a very serious borer in south-east Asia and has been introduced into Hawaii, South Africa and Madagascar (1), a fate which Fiji has so far been spared. This insect is pale brown, one-third of an inch in length

and has a life cycle in the East Indies of two to three months. It is so resistant to cold that it endures a temperature of -12°C. (10.4°F.) for 5 days and 15 per cent. of beetles existed for 50 days at -2°C.(28.4°F.), (2).

In June a consignment of potatoes from the Department of Agriculture, Northern Ireland, was found to be infested with fly puparia from which emerged a fly, identified by the Imperial Institute of Entomology as *Muscina stabulans* Fall. This insect has recently been recorded as a pest of iris bulbs in Hungary, beet seed in Germany and onions in Russia and is known to breed generally in decaying plant and animal matter. In North China it is said to be a pest inside homes which is in some contrast to Australia where it does not enter houses as much as, but is more attracted to food than the common house-fly (3). All specimens found were collected and destroyed.

A moribund larva of the dreaded codlin moth *Cydia pomonella* L. was found in August by the writer in an apple imported from California. This caterpillar does severe damage both in Australia and New Zealand, but as apples cannot grow in Fiji it has not established itself here and this singleton died without pupating. The mid-temperature for August was 74·5°F.

The writer is obliged to the three officers concerned for passing on rapidly the infested seeds or tubers which, it will be noted, contained in each case live insects of potential harm to various kinds of planting material in the colony. It is extremely difficult to guarantee absolute cleanliness of exported seeds and other plant matter which accounts for the spread of certain insects to remote parts of the world.

(1) Dammerman, K. W., 1929. "The Agricultural Zoology of the Malay Archipelago." (Amsterdam.)
(2) Diakonoff, A., 1938. *Landbouw*, No. 14. (Java.)
(3) Tillyard, R. J., 1926. "The Insects of Australia and New Zealand." (Sydney.)

CULTIVATION OF MAIZE.

By
D. A. DONALD, H.D.A., Agricultural Officer,
and
B. E. V. PARHAM, M.A., Agricultural Officer.

MAIZE is commonly grown throughout Fiji on all types of soil and in "wet" and "dry" zones. It is tolerant of a wide range of soil and climatic conditions, and responds well to superior husbandry.

Maize is a heavy consumer of plant food and a rich deep loamy soil as is found on some well drained alluvial or "bila" areas give the best results.

The field should be ploughed eight to ten inches deep and harrowed and cross-ploughed two or three weeks later. After one or two harrowings the area should be ready for drilling and planting. Thus preparation should commence six or eight weeks prior to the selected planting date.

The time of planting depends on weather conditions; in the dry zone it usually coincides with the beginning of the wet season, that is November to December, and the end of the wet season, May to June. In the wet areas maize may be grown at all seasons; but the most favourable planting time is during the months of May and June. Wet weather at flowering time interferes with pollination. From the end of July to the beginning of October is the period of short supplies on the market in Fiji.

The seed for the next sowing should be selected in the field from healthy, robust plants bearing large well-filled cobs, which upon maturity may be tied into bundles and hung up to dry thoroughly until wanted.

The width apart of drills should be about four feet. With tall-growing varieties on rich soil this may be increased to five feet to allow plenty of sunlight to encourage proper fertilization of flowers nad hence good setting of cobs. The spacing in the drills may be 15 to 18 inches.

The quantity of seed required to the acre varies from about 8 lb to 20 lb.

The tendency in Fiji is to plant drills too close and hand-dropping of seed in the drills is often carried out very wastefully. It is not necessary or desirable for the drills to be in straight lines except on very flat lands. On sloping land the drills should follow the contour of the slope, thus conserving moisture and reducing soil erosion.

After-cultivation consists of keeping down weeds by hoe or cane knife and maintaining tilth by frequent cultivations with the single animal-drawn scarifier up to the time of tasselling.

Hilling with the single furrow plough is commonly practised in Fiji. It is doubtful if the usefulness of this practice is as great as is supposed. Much damage can be done to the root systems of the plants by ploughing close to the rows in a full-grown crop. Therefore, if hilling is necessary to smother young weed growth in the rows it is best done early when the plants are two to three feet high and before the roots have extended far between the rows.

The common Fiji maize takes about five months to mature and a crop is fit to harvest when the stalks have turned yellow.

The usual practice in Fiji is to strip the cob free of the husk on the plant, leaving the husk behind. This is necessary to enable quick drying of cobs and to reduce risk of weevil damage. In the wet zone, particularly, maize must be harvested immediately on maturity and dried thoroughly, without delay.

The cobs usually need to be sun dried but well-built covered lofts of open laths would probably serve to dry the cobs sufficiently for shelling.

Shelling is usually done with small hand machines costing 25s. to 30s. Where the area cropped justifies it, or where a number of small farmers can club together, the large two-hand machine costing £5 to £7 is more satisfactory and more economical.

The shelled grain needs to be well cleaned by winnowing and thoroughly dried by spreading on mats in the sun and stirring frequently. It is then ready for bagging and for the market.

The best varieties to grow are the local strain of "90 Days" and the "Improved Yellow Dent." The "White Hickory King" also does well in the wet zone and provides much fodder for stocks.

REVIEW.

PADI FARMING IN CEYLON.

THE preparation of land, including clearing, levelling and bunding is said to cost Rs 300 per acre. In addition it is estimated that fencing, housing, water supply, implements, household utensils, the simplest furniture and live stock will cost Rs 100 per acre on a 25-acre holding. —H.W.J.

(*Tropical Agriculture*, Vol. No. 6, 1939.)

SUMMARY OF A REPORT ON THE RECENT MISSION OF MR. H. W. SIMMONDS TO JAVA, MALAYA, MAURITIUS AND MADAGASCAR.

Mr. H. W. Simmonds, O.B.E., F.R.E.S., formerly Government Entomologist, Fiji, has recently returned from a mission to Malaya, Mauritius, Java and Madagascar, undertaken jointly on behalf of the administrations of Fiji and Samoa, in an endeavour to obtain natural enemies for the control of the Rhinoceros beetle (*Oryctes rhinoceros* L.) in Samoa and of houseflies in Fiji, Samoa and the Solomon Islands.

HOUSEFLIES.

The absence of houseflies in the cattle districts of Java and the fact that the annual epidemic outbreaks of these pests in Fiji have been shewn to be directly traceable to the fact that they are able to use cattle droppings as they lie in the field as a breeding media, suggested that in Java and other parts of the East natural enemies were present in such situations and thus tending to hold them in check.

Search in Java shewed that such a suitable predator, an Histerid beetle, *Platylister chinensis* did actually occur and was capable of eating as many as 27 full-fed maggots in twenty-four hours and strong colonies of this species were successfully transported to Fiji, Samoa and the Solomon Islands. Mr. Love of Messrs. Lever Bros. reported that the beetle was breeding in that group, whilst on his return to Fiji, fifteen months after their release in that group, the writer had no difficulty in recovering them in the neighbourhood of Suva where they were released in November, 1938.

In South Africa, where short leave was spent, a Copriid *Onitis alexis* Klug. was observed to be doing useful work in burying cattle droppings, whilst the Histerid *Placodes caffer* was also found, in the same situations but was scarce.

RHINOCEROS BEETLE.

No true parasites of *Oryctes rhinoceros* L., were found in Malaya or Java. The predatory beetle, *Catacopus facialis* Wied., was found to eat the small maggots greedily and a colony of these was successfully shipped to Samoa. Investigation failed to show that the Scoliid, *Scolia ruficeps*, was a true parasite of these grubs although it is possible that a biological race of this species may use these beetles as a host.

As the Dutch in Java had shewn that *Scolia oryctophaga* of Madagascar and Mauritius was capable of successfully breeding upon *O. rhinoceros*, it was decided to proceed to these islands and endeavour to introduce this species. Collections were made by Mr. Simmonds in Madagascar, whilst Mrs. Simmonds collected in Mauritius, and a total of four hundred and twelve adult females was obtained. One hundred and eighty of these were shipped by air to Sydney and thence by steamer to Samoa, arriving in splendid condition, one hundred and fifty flying strongly away. The balance were taken by sea and, despite the much longer journey, sixty-three survived in good condition: some fifteen pupæ were also transported. The success of the airshipment was made possible by the use of an agar and honey jelly, in the proportion to 6 to 8 grammes of agar to 200 cc. of water and 300 to 320 cc. of honey. The outbreak of the war prevented full investigation into a second Scoliid, *Scolia ruficornis* F. a native of Zanzibar but half a dozen females captured attacked freely *Oryctes rhinoceros* grubs in captivity. They were not however, bred through, but gave every indication that they could use this species as a host. In this case they would probably be a much more valuable parasite than *oryctophaga* since they are apparently continuous brooded, whereas *oryctophaga* seems to be single-brooded.

A number of other matters were investigated, such as noxious weeds, &c., but space does not permit a review of them in this number.

VANILLA.

NOTES ON CURING TAHITI VANILLA BEANS.

THE process for curing Tahiti vanilla beans is not very complicated, but requires a certain amount of skill and patience.

First of all, the beans should be picked quite ripe, that is, when they show a yellowish colour. The flowers grow in clusters and each flower has to be fertilized by hand to bear a bean.

When ripe beans have been picked, they may be left in a heap on the wooden floor of an airy room and covered with a cloth or blanket. After some days, say from about six to ten days, when every bean becomes a dark brown colour, they are washed freely in cold water to eliminate dust or any extraneous particles. This must be done on the morning of a good warm sunny day, so that, as soon as they are washed the beans can be spread out on long tables fully exposed to the sun. Black blankets form the best cover for the beans as they prevent the direct heat of the sun from striking the beans. When the beans are quite warm, at about 2 p.m., they should be carefully gathered in neat bunches, placed in large shallow tins and when the tins are almost full, the hot blankets should be folded to cover the top of each tin. The most suitable tins for handling vanilla beans are large-sized saloon biscuit tins. The full tins of beans should be stored during the night. The same process must be repeated daily for from two to three weeks after which time the beans will become wrinkled and will look shiny and oily. Then they are spread on shelves made of galvanised wire netting of suitable mesh to prevent the beans from falling through. The shelves should be about three feet wide and from five to six feet long, built with light wood, the lowest one standing about two feet from the ground floor and each shelf separated from the others by about twelve inches. The number of shelves required depends on the amount of vanilla beans to be treated.

After spreading the vanilla beans on the shelves in the fermenting room, they must be handled every day, that is, each bean must be held by the lower end between thumb and finger of one hand and with the thumb and forefinger of the other hand it should be lightly squeezed and rubbed from the lower end of the bean to the curved end of it—this process softens the beans and also tends to distribute some of the essential oil towards the thinner end of the beans which otherwise has a tendency to get too dry and brittle.

While this process is taking place over some weeks, the beans, which are starting to become dry, are stored away in tins and kept well covered to prevent them becoming too dry. When all the beans are dry they are measured to classify them into separate groups, differing by quarter inches. Finally they are tied into bundles of 50 to 60 by thin string near the ends of each bundle. Usually curved beans are placed in the centre of the bundles and straight ones on the outside.

The whole curing process takes about three months and should never be accelerated—the slower the better.

No "dopes" are used in the process and Chinese do practically all the curing—the fresh beans usually being purchased as signs of maturity are showing. The purchase price of fresh beans for curing is usually about one-third of the estimated price for the fully-cured beans. The present price of the finished article varies from 97 to 120 francs. In 1938, the export of vanilla from Tahiti amounted to approximately 125 tons being distributed to London, France, America, Australia and New Zealand.

These notes have been generously contributed by Mr. H. H. Hemus of Messrs. A. B. Donald & Co. of Auckland and Tahiti and are gratefully acknowledged.

(The term bean is used in these notes in place of the more correct term "pod.") —H.W.J.

REVIEWS.

THE STORAGE OF ROOT CROPS.

THE storage of tropical root crops in a fresh condition is a more difficult problem than the storage of grain owing to the large amount of water they contain. There is a marked difference moreover in the case of storage of different kinds of produce. Thus yams are comparatively easily stored, while it is practically impossible to store cassava satisfactorily for any length of time once the roots have been dug.

The most satisfactory method of storage of sweet potatoes and cassava, when the preservation of considerable quantities of such products is involved, is to slice them and to convert them into dried chips. Slicing into pieces about half an inch thick, with or without peeling, and drying the slices in the sun by exposure on drying floor is a common practice in parts of Africa. The process presents no difficulty except that the slices require to be protected from rain during drying since if they are wetted they are liable to become leathery and an unsatisfactory product results. Chipped or sliced root crops can be stored in the same way as dried grain and the same precautions require to be observed as they are equally liable to become damaged by insect attack or mould growth.

YAMS.

For storage in a fresh condition it is important that the tubers should be fully ripe before they are lifted; they are ready for digging when the foliage has become dry. So long as dry weather persists the tubers can be left in the ground, as is common in parts of West Africa, and lifted as required for consumption, but the usual practice is to harvest the yam crop as soon as it is ripe. The tubers should be dug very carefully so as to avoid bruising, as bruised tubers do not store well. After lifting, the tubers should be left exposed to the air for a few hours and then stored on shelves in a well ventilated, cool, shaded room or stored in layers three or four feet deep. Yams are also stored in carefully packed heaps within weatherproof buildings and sometimes in pits. The latter method cannot, however, be recommended unless the soil is thoroughly dry and likely to remain so. Buds and eyes should be removed as soon as they show signs of sprouting, and as bruised tubers are liable to attack by moulds if not removed, they should be treated with slaked lime to prevent spread of infection. Under all conditions of storage yams require to be regularly inspected to ensure the removal of all diseased tubers, otherwise infection will spread rapidly, resulting in considerable loss. Under favourable conditions yams can be held in storage for several months, some varieties being much more suitable for lengthy periods of storage than others.

CASSAVA.

Cassava roots do not store well for any length of time after they have been removed from the ground. Under certain climatic conditions it is dangerous to attempt to do so. The crop can, however, particularly in dry areas, be allowed to remain in the ground for several months before deterioration sets

in and the most satisfactory method of storing in a fresh condition is to allow the crop to remain in the ground, digging supplies as required for immediate consumption. Certain varieties of cassava can be left undug for much longer periods than other without undue detriment to the starch content of the tuberous roots.

Cassava lends itself very well to the preparation of dried chips and if for any reason it is impracticable to leave the crop in the ground this is the best procedure. In wet districts or in areas liable to insufficient drainage, cassava cannot be satisfactorily left undug, and if production is in excess of consumption needs the surplus should be converted into chips or meal. When the chips are required for use they may be pounded and sieved to remove the fibre from the meal.

Cassava meal may also be prepared directly from the fresh cassava, as is the usual practice amongst the aboriginal Indians in British Guiana and the Mayas in British Honduras. In the former Colony, the roots are cleaned and then grated upon what resembles an English grater which has been beaten out flat and nailed to a small piece of board. The resulting meal is then stuffed into a basket-like cylinder which has loops attached to either end. One of these loops is attached to a beam in the house, whilst through the lower loop is passed a stout stick which is pulled upon so that the wicker cylinder, owing to the pressure, gradually becomes longer and longer. The watery contents so expressed are collected and boiled to form the cassareep which is used for the preservation of meat. The meal remaining in the cylinder is then taken out and rubbed through a sifter. It is then either dried in the sun or baked into thin cakes on large flat iron plates. Cassava meal and cakes form an important item of the diet of the Indian tribes of tropical South America.

SWEET POTATOES.

Considerable attention has been given to the storage of sweet potatoes in the United States of America and a technique of storage which has apparently given satisfactory results has been evolved there. The essential points of the process are a preliminary curing process of ten days to two weeks duration at a temperature of 80° to 85° F., followed by storage in specially constructed stores at a temperature of 55°F. Such conditions are, however, unattainable under normal conditions in the tropics. Various methods have been attempted under tropical conditions and storage in pits or clamps has on the whole given the best results. In some recent trials in Barbados, the clamps were prepared by digging out the soil to make a shallow circular depression 3 to 4 inches deep and about 3 feet in diameter. The potatoes were stacked in this in a conical heap. The heap of potatoes was then covered with trash and a layer of soil placed over the trash. This method of storage was considered to be very successful and quite practicable in areas where pests affecting sweet potato tubers are not prevalent.

Results in Trinidad have also shown that under suitable conditions sweet potatoes can be stored in this way for about two months in fairly good condition with a loss in weight of about 15 per cent.

Some varieties keep very much better than others and it is generally held that the red-skinned types are to be preferred for storage to the white or yellow-skinned types. The sweet potato, known in Trinidad as Black Rock, has a reputation for storage purposes.

In storing sweet potatoes care has to be taken to protect the skin from injury by bruising or cutting as it is very delicate and if injured decay spreads rapidly.

—The Storage of Foodstuffs in the Colonial Empire, 1939—(Colonial Office).

PASTURE IMPROVEMENT.

Stapledon in drawing attention to the importance of the English Government's lime and slag policy for the improvement of pasture (grassland) mentions that the improvement of permanent grass can never be carried very far by means of lime and slag alone.

The improvement of grassland should be conducted in the following order:—

The elimination of roughage, drainage, and the improvement of fertility status. Stapledon considers that the removal of roughage and the consequent encouragement of even grazing is the most important operation in improvement. Therefore a mow-over is generally essential for the improvement of poor rough pastures and the use of the mower for the elimination of weeds is described.

Stapledon strongly emphasises the desirability of the correct sequence in all grassland improvement and after dealing with mowing and the elimination of roughage he describes in detail the use of various fertilizers. The mowing machine is considered as an intermediary and better grasses as the culmination of improvement.

Slag and lime are the most important inorganic materials required on most British grasslands, but it must be remembered that liming with or without slag, should be accompanied by dressings of nitro-chalk to bring about the most rapid improvement. Ground limestone is considered in many ways to be the best form of lime but, provided the soil is not too deficient in calcium, heavy dressings of slag may be enough to correct the lime status. It is not always realised that both phosphorus and lime are essential for the successful growth of the better grasses and that with the stimulus given to the clovers, the nitrogenous manuring can be left to the stock if the grazing is correctly managed.

Watson (Scotland) classifies lowland grassland, which is in need of improvement, into three main types according to the main cause of the poor condition. First, there is poor land which is deficient in lime. Second, there is much grassland of a slightly acid nature but quite satisfactory from the point of view of clover and the grass growth, but which is deficient in phosphates. Third, must be considered all those areas which are primarily in need of drainage, before any other form of improvement can be attempted.

Hanley stresses the importance of improving lowland pastures and maintains that ploughing out and resowing are not as expensive as is generally thought. He describes work in heavy land in which new pastures have been formed successfully after taking two corn crops.

Robinson and Pierre (United States of America) showed that lime together with balanced dressing of nitrogen, phosphate and potash increase desirable plants in the sward. Calcium and phosphorus alone increased the yield anything between 38 per cent and 87 per cent., according to the soil type and condition, while complete fertilizers and lime gave increase as high as 227 per cent.

The botanical composition of the herbage materially affected the response to fertilizers. Calcium and phosphates gave large increases when white clover was represented plentifully, while nitrogen was much more effective when the clover was absent.

The effect of the grazing of grass land by poultry is similar to that of heavy dressing with phosphate. Heavy stocking induced a richer herbage with more protein, lime, phosphorus, carotene (Vitamin A) and ascorbic acid (Vitamin C).

—C.R.T.

(*Journal Royal Agricultural Society*, England, 1939.)

RESEARCH WORK ON INSECTICIDES.

An interesting paper* by Drs. Martin and Tattersfield deals with recent progress on insecticides which is now no longer a matter of choosing some arsenical on the assumption that what is poisonous to man must therefore also be poisonous to insects.

Fluorides have recently had a favourable " press " but since the discovery that even minute quantities may produce a form of tooth disease, their use has naturally not expanded.

The substance phenothiazine besides being a potent poison against mosquito larvæ (" wrigglers ") has the useful property that when fed in minute amounts to cattle it renders their droppings so unpalatable or poisonous to horn-fly maggots that they are unable to develop.

Arsenic in some form or other will not be easily displaced as only $\frac{1}{4}$ ounce of white arsenic (costing 1/20 of a penny) can totally destroy colonies of white ants each numbering half a million individuals in Australia. Workers in that country have also found that jetting fluids containing up to one per cent. arsenic give protection to sheep from blow-fly while ordinary dips are said to be of little value. Even more improtant is the discovery of glyceroborates which when smeared on the sheep kill the maggots and help the wound to heal. Unfortunately the demand for glycerine in the manufacture of high explosives will tend to make the price prohibitive and substitutes are therefore being sought.

Impregnation of blankets and felts with chromium-and sodium-antimony fluorides makes these materials moth-proof which is clearly of great value to the Quartermaster side of the Army. Petrol is now tending to be used, so far as insecticides are concerned, merely as a vehicle for more potent insecticides such as tar distillate oil for controlling red spider, winter moth and aphid. Heavy petroleum oils and kerosene are also used as carries of pyrethrum for household and warehouse fumigation.

Nicotine continues its importance as it acts in so many ways *e.g.* stomach poison, contact for eggs, larvæ and adults and as a poisonous vapour. With regard to derris (a Fijian species is *duva*) an increase of the active principal (rotenone) has been found in Malaya to be questionable beyond a certain point as increased yield of marketable root per acre may offset mere increase in percentage of rotenone. This material is much less poisonous to warm-blooded animals than are arsenicals and the loss of poison on its exposure to sunlight and air make it ideal for use on market garden crops. Pyrethrum, made from chrysanthemums, has the best " knockdown " effect of any known insecticide and has the peculiar property of being more poisonous to male houseflies than to females. Like derris, pyrethrum loses its power when exposed to sunlight and air but is ideal for fumigating warehouses when mixed with heavy petroleum oil and should be very efficeint for the control of the local fig moth *Ephestia* in copra sheds.

The authors stress the importance of segregation of goods and cleanliness in addition to fumigation and conclude by referring to evidence that certain scale insects on citrus are becoming very resistant to prussic acid gas and certain caterpillars on apples may become more and more tolerant to increasing proportions of lead arsenate sprayed on the fruit.

—R.J.A.W.L.

* *Chemistry and Industry*, Vol. LVIII, No. 27. July 8th 1939.

EXTRACTS.

FIGHTING THE EMPIRE'S PESTS.

(*Overseas*, XXIV, *No.* 281, *June*, 1939.)

THE British Empire produces one-eighth of the total grain crop of the world, one-sixth of all the cotton produced, one-quarter of the sugar output, one-third of the world's production of tea, over half the rubber and wool exported, and high proportions of the lesser agricultural products. To the development of these vast agricultural resources no one has contributed more than the Government entomologists of this country, the Dominions and the Colonies.

The value of their work can best be illustrated by examples of the damage pests have actually caused in Empire countries. Until a few years ago blow-flies were calculated to have cost sheep farmers in New South Wales alone £2,000,000 a year. Piri-piri* weeds cost New Zealand farmers £250,000 annually. India in one year lost £1,000,000 worth of rice from leaf-hoppers in one division of the Central Provinces, and Ceylon tea planters paid out £350,000 a year to fight a little boring beetle. Even Great Britain lost one-eighth of her annual oats crop through the frit-fly and £400,000 was the figure given for the damage caused to hides by the ox warble-fly.

The control of such dangerous pests as these was for many years attempted by applications of chemicals. Pest-destroying chemicals are, however, expensive to buy in the large quantities required and equally expensive to apply on a big scale. Recently, increasing attention has been paid to natural methods of control and at the Parasite Breeding Station in the village of Farnham Royal in Buckinghamshire is the headquarters of the most remarkable pest-fighting organisation in existence.

It is here that insect enemies of the Empire's crop pests are bred for dispatch in armies to all parts of the wrold. A natural enemy can be found for most plant and insect pests, but the most careful experiments are necessary before a parasite army is sent overseas. There is always the danger that the parasites may exterminate the pest and then become a pest themselves.

Working in conjunction with the Farnham Royal Parasite Station is the Rothamsted Experimental Station in Hertforshire. Its staff of experts have the responsible task of advising on the chances of a parasite army turning pest. Not long ago a certain species of caterpillar was being bred at Farnham Royal at the request of the New Zealand Government for war on a blackberry pest. Then it was discovered that these caterpillars would eat raspberries and loganberries, so the project had to be abandoned.

The most useful insect ever bred at Farnham Royal is the minute ichneumon-fly, an insect that lays its eggs in or on the larvæ of other insects. It was this insect that conquered the earwig plague in New Zealand. Two hundred and fifty thousand ichneumon eggs were sent out from Farnham Royal and the flies, when hatched out in New Zealand, began to lay their eggs inside the earwigs' eggs with disastrous consequences to the ear-wig population.

The same fly overcame the blow-fly menace to sheep in Australia. These blow-flies lay their eggs in the nostrils of the sheep and caused enormous loss. Millions of ichneumon-flies, sent to Australia in the pupa state, laid their eggs on the bodies of the blow-flies and the larvæ, eating their way into the blow-flies, killed off the latter in millions.

**Acæna* spp. Noxious burrs of the rose family.—Editor, *Agricultural Journal.*

Wasps are another species of insect used in the world's anti-pest war. Only the other day over a million Hungarian wasps were sent in the pupa state to Canada where it is hoped they will attack the corn-borer, one of the most destructive pests in the world. Another kind of wasp, the cannibal wasp of Uganda, is now fighting the woolly-aphis on the coffee plantations of Kenya. This came about in rather a remarkable way. In East Africa these wasps had been known for some time to be an enemy of the woolly-aphis, but there were no facilities for breeding them in sufficiently large numbers. So a few specimens were caught and sent to England, and in the breeding boxes at Farnham Royal a large army of cannibal wasps was bred to be sent as pest-fighters to Kenya.

The pretty little ladybird beetle is also used in the front line of the pest war. The grubs of these beetles are famous for their skill in chasing and catching greenfly larvæ, and they have also been used to control aphids.

It is not only for war against insect pests that the Farnham Royal parasites are used. New Zealand's burred piri-piri weeds are kept back to-day by a Chilean sawfly that feeds on the leaves. Other weeds in New Zealand are also controlled by insects free of all cost to the Government or the farmer. Two million eggs of the cinnabar moth sent out from Buckinghamshire a few years ago did away with the menace of the ragwort weed. To prevent encroachment of gorse on farm land an army of seed-boring beetles was imported. To combat the prolific blackberry weed, special beetles were obtained from the south of France, bred in large numbers at Farnham Royal and sent to the entomology station at Nelson, New Zealand, from where they were distributed all over the Dominion. Latest reports tell of a decrease in the acreage under blackberry weeds, but also hint at the danger of these insects attacking other plants, such as rose trees, which are particularly subject to attack from these beetles. In a few years' time the New Zealand Government may be obliged to appeal to Farnham Royal for a parasite to kill the blackberry weed exterminators.

In tropical climates, such as India, where the number of insects is already so great, the dangers of importing a new species have hitherto prevented much pest preventive work of this type.

Now, however, there are signs that India and other tropical countries of the Empire are waking up to the possibilities of insect parasite control. As a result, the entomologists at Farnham Royal and Rothamsted may soon be set a series of problems on tropical insects that will dwarf any query sent them from the Dominions. —J.H.

BROWN BREAD OR WHITE BREAD?

THE following notes are taken from the New Zealand *Journal of Agriculture*, Volume 50. No, 5 of 1939, and may be of interest locally where casual labourers on the wharves are usually given rations of white bread and tinned salmon.

The following is an analysis of average wheat products:—

Product.	Water.	Protein.	Carbohydrate.	Fat.	Minerals.	Roughage.
White flour.. ..	10·54	11·99	75·16	1·61	0·5	0·2
Bran	9·99	14·02	59·40	4·39	6·06	6·14
Wholemeal flour ..	10·81	12·26	71·5	2·24	1·02	2·17
Germ	8·73	27·24	46·49	11·23	4·71	1·6

It will be seen in the above table that wholemeal flour contains more protein, less starchy matter, appreciably more fat, twice as much mineral matter, and ten times as much roughage.

The following table shows the comparative mineral and vitamen contents in grammes in a slice of bread, 3½ in. x 3½ in. x 1 in.:—

	Lime.	Phos.	Iron.	Vit. A.	Vit. B.	Vit. C.	Vit. D.
White bread	·009	·029	·0003	negligible	negligible	negligible	negligible
Wholemeal bread ..	·015	·075	·0006	good	very good	negligible	good

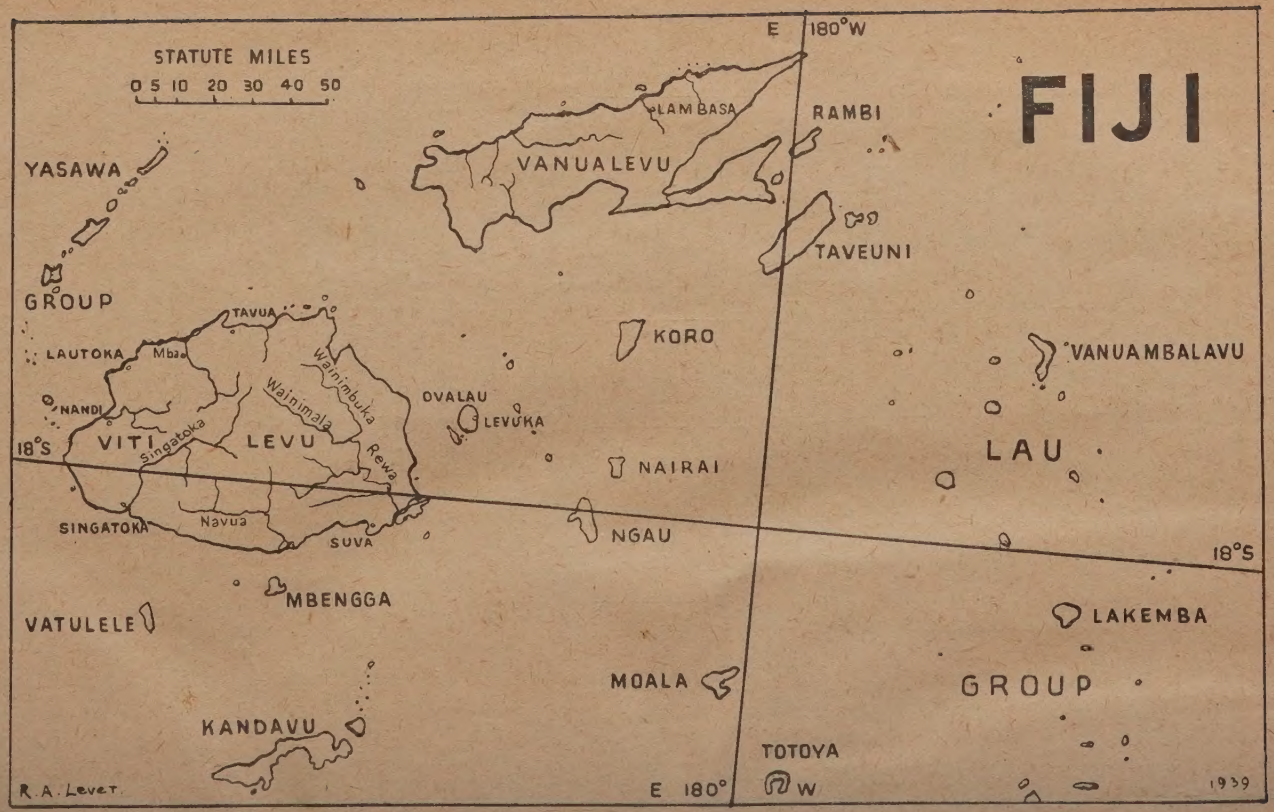
The above table indicates that wholemeal bread contains approximately twice as much lime as white bread, approximately three times as much phosphates and twice as much iron. All four vitamens are lacking in white bread, while all but Vitamen C are present in good quantity in wholemeal bread.

"In an accurate study of actual family menus" in New Zealand . . . "the amounts of calcium (lime), phopshorus and iron were low. It seems probable that the low calcium and phosphorus content of the diets, together with their high sugar contents, may have a direct bearing on the poor teeth and high incidence of dental caries in New Zealand." . . . . . "White flour in the process of milling is deprived of important nutritive elements. Its use should be decreased and patrial substitution by lightly-milled cereals, and especially by potatoes, is recommended." . . . . . "In order to provide a margin of safety, especially in regard to Vitamen B, consumers should aim at either:—

(*a*) consuming a liberal serving of wholemeal or other whole-grain product twice daily (for example, whole-grain porridge or other whole-grain breakfast cereal, and wholemeal bread or scones or some such food as the sole or main starchy food at another meal); or

(*b*) using as much wholemeal flour and bread as they do white flour and white bread."

Judging from the above notes, and taking into consideration the fact that tinned salmon is freely issued as the attractive portion of the local wharf labourer's ration, it would seem advisable that the white bread now issued should be replaced by wholemeal bread with some benefit to the consumers.


FIJI
STATUTE MILES
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YASAWA
GROUP
LAMBASA
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LAUTOKA
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Wainimbuka
Wainimala
Rewa
VITI
LEVU
Singatoka
18°S
KORO
OVALAU
LEVUKA
NAIRAI
VANUAMBALAVU
LAU
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